Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Four Year Multidisciplinary Degree (Honors/Research) Programme with Multiple Entry and Exit option

Undergraduate Programme of Science and Technology

B.Sc. (Honors/Research) in Chemistry

Board of Studies

in

Chemistry

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

w.e.f. June, 2023

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. (Honors/Research) in Chemistry** to be effective from the **Academic Year 2023-24.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 14/07/2023

Place: Latur

NEP CELL

Rajarshi Shahu Mahavidyalaya, Latur

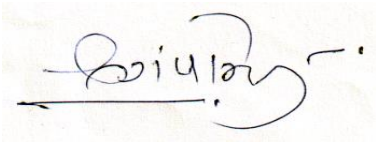
(Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Honors/Research) in Chemistry** Programme to be effective from the **Academic Year 2023-24.**

Date: 14/07/2023

Place: Latur



Prof. Dhananjay Palke

Chairperson
Board of Studies in Chemistry
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Members of Board of Studies in the Subject Chemistry
Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Prof. Dhananjay Palke** Head, Department of Chemistry, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur	Chairperson	HoD
2	**Prof. Vijay Bhosale** Department of Chemistry, Yeshwant Mahavidyalaya, Nanded. Mo.No.9403067252	Member	V.C. Nominee
3	**Prof. S. P. HangiragekarDepartment of** Chemistry, Shivaji University, Kolhapur Mo.No.9890363931	Member	Academic Council Nominee
4	**Dr. Bapu B. Shingate** Department of Chemistry, Dr. B. A. M. U. Aurangabad Mo.No.9850298591	Member	Academic Council Nominee
5	**Prof. S. B. Patwari** Chemistry, Laal Bhadur Shastri, Mahavidyalaya, Dharmabad Mo.No.9067583746	Member	Expert from outside for Special Course
6	**Dr. Pinak M. Chincholkar** Springer Nature Technology & Publishing Solutions. Tower 8 and 9 Magarpatta City, Hadapsar. Pune. Mo.No.9823966381	Member	Expert from Industry
7	**Dr. R. V. Hangarge** Department of Chemistry, Tai Golwalkar Mahavidyalaya, Ramtek. Mo. No. 9075641697	Member	P.G. Alumni
8	**Dr. K. I. Momin** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
9	**Dr. K. C. Tayade** Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512	Member	Faculty Member
10	**Mr. M. S. Sudewad**	Member	Faculty Member

Sr. No.	Name	Designation	In position
	Assistant Professor, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur-413512		
11	**Dr. K. D. Sawant** Department of Botany , Rajarshi Shahu Mahavidyalaya, (Autonomous) Latur 413512	Member	Member from same Faculty

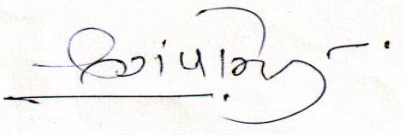
From the Desk of the Chairperson…

The Department of Chemistry was established in the academic year 1971-72. Need of Chemist, is at the forefront of the noteworthy growth in industries, the college took initiative in starting the B.Sc. Chemistry Program from 1971-72 at Undergraduate (B.Sc.) level. Now, this course is successfully flourishing the need of industries by availing Chemist with sound subject knowledge. Also, Post graduate Program in Chemistry started from Academic Year 2014-2015. From Academic Year 2023-24 we are implementing National Education Policy-2020 (NEP-2020) & Started B.Sc. (Honors/Research) Chemistry Programme to be effective from the same academic year. Department has well equipped laboratories with number of sophisticated instruments. In 2006-07, UGC recognized this department as a "Star Department" in the college and awarded CPE status.

The B.Sc. Chemistry Programme is designed to give sound knowledge and understanding of Chemistry to undergraduate students of the B.Sc. Degree course. The goal of the Programme is to make the study of Chemistry as stimulating, interesting, and relevant as possible. The curriculum is prepared with the aim of making the students capable of studying Chemistry in academic and industrial courses. Also, to expose the students to Chemistry and build up their interest in various fields of chemistry. The new and updated Curriculum is based on National Education Policy-2020 (NEP-2020) Guidelines which includes multiple entries & multiple Exit & interdisciplinary approach with vigor and depth. The curriculum is designed on the basis of Feedbacks & suggestion given by Various Stakeholders and by considering the syllabi of Competitive examination like, IIT-JAM, NET, SET, GATE examinations, UGC model curriculum, syllabi of different entrance examinations and syllabi of other Universities.

Our Vision to evolve as a world class dynamic center of higher education disseminating knowledge rigorously at affordable cost and to emerge as a premier centre that promotes technological competence and democratic values.

* "Pursuit of Excellence" in higher education to make our students globally competent.
* Enable students to develop as responsible citizens with human values.
* Provide value and need based education.
* Develop scientific attitude among students.



Prof. Dhananjay Palke
Chairperson
Board of Studies in Chemistry
Rajarshi Shahu Mahavidyalaya, Latur
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Faculty of Science and Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in Chemistry Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	GE/OE	VSC/ SEC (VSEC)	AEC/ VEC	OJT,FP,CEP, RP	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE							
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**10**
I 4.5	I	DSC I: 04 Cr. DSC II: 04 Cr.	NA	NA	GE-I: 04 Cr.	VSC-I: 02 Cr. SEC-I: 02 Cr.	AEC-I MIL: 02 Cr. VEC-I: 02 Cr.	CC-I: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-I: 02 Cr. (SES-I)/ OJT: 02 Cr. / Mini Project: 02 Cr.	22	44 Cr. UG Certificate
	II	DSCIII: 04 Cr. DSC IV: 04 Cr. (IKS)	NA	NA	GE-II: 04 Cr.	VSC-II: 02 Cr. SEC-II: 02 Cr.	AEC-II MIL: 02 Cr. VEC-II: 02 Cr.	CC-II: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-II: 02 Cr. (SES-II)/ OJT: 02 Cr. / Mini Project: 02 Cr.	22	
	Cum. Cr.	16	-	-	08	04+04=08	04+02+02=08	04	44	
Exit Option: Award of UG Certificate in Major with 44 Credits and Additional 04 Credits Core NSQF Course/Internship or continue with Major and Minor										

Abbreviations:

1.	DSC	: Discipline Specific Core (Major)
2.	DSE	: Discipline Specific Elective (Major)
3.	DSM	: Discipline Specific Minor
4.	OE	: Open Elective
5.	VSEC	: Vocational Skill and Skill Enhancement Course
6.	VSC	: Vocational Skill Courses
7.	SEC	: Skill Enhancement Course
8.	AEC	: Ability Enhancement Course
9.	MIL	: Modern Indian Languages
10.	IKS	: Indian Knowledge System
11.	VEC	: Value Education Courses
12.	OJT	: On Job Training
13.	FP	: Field Projects
14.	CEP	: Fostering Social Responsibility & Community Engagement (FSRCE)
15.	CC	: Co-Curricular Courses
16.	RP	: Research Project/Dissertation
17.	SES	: Shahu Extension Services

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Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science & Technology

Programme Outcomes (POs) for B.Sc. Programme	
PO 1	**Academic Competence** Knowledge of various concepts of Organic, Inorganic and Physical Chemistry.
PO 2	**Scientific Outlook** An ability to perform and demonstrate experiments in Chemistry to study Stoichiometry, Kinetics, Thermodynamics of Chemical reactions, Synthesis of Organic and Inorganic Compounds, Analysis of Organic and Inorganic Compounds Qualitatively and Quantitatively.
PO 3	**Personal and Professional Competence** Core competency, Systematic and coherent understanding of the fundamental concepts in Chemistry and allied subjects.
PO 4	**Entrepreneurial Competence** Opportunity to act as team player by contributing in laboratory, field based situation and industry.
PO 5	**Research Competence** Advanced research skills, competency for basic tools needed to carry out independent chemical research and acquire proficiency in their specialized area of chemistry.

Programme Specific Outcomes (PSOs) for B.Sc. Chemistry (Honors/Research)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Have firm foundations in the fundamentals and application of current chemical and scientific theories.
PSO 2	integrate their knowledge from each of these areas with critical thinking skills in order to become problem solvers
PSO 3	Be proficient in the chemistry laboratory, especially with respect to the abilities to follow and understand general laboratory practice guidelines, including safety. Perform qualitative & Quantitative chemical analyses. Perform chemical synthesis &Understand and use modern chemical instrumentation.
PSO 4	Find gainful employment in industry or government, be accepted at graduate or professional schools (law, medicine, etc.), or find employment in school systems as instructors or administrators.
PSO 5	Demonstrate a systematic or coherent understanding of the fundamental concepts, principles and processes underlying the academic field of chemistry, its different subfields (analytical, inorganic, organic and physical), and its linkages with related disciplinary areas/subjects;
PSO 6	Demonstrate a procedural knowledge that creates different types of professionals in the field of chemistry and related fields such as pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.;
PSO 7	Demonstrate a skills related to specialisation areas within chemistry as well as within subfields of chemistry (analytical, inorganic, organic and physical), and other related fields of study, including broader interdisciplinary subfields (life, environmental and material sciences).
PSO 8	Apply appropriate methodologies in order to conduct chemical syntheses, analyses or other chemical investigations; and apply relevant knowledge and skills to seek solutions to problems that emerge from the subfields of chemistry as well as from broader interdisciplinary subfields relating to chemistry;
PSO 9	Use chemical techniques relevant to academia and industry, generic skills and global competencies, including knowledge and skills that enable students to undertake further studies in the field of chemistry or a related field, and work in the chemical and nonchemical industry sectors.
PSO 10	Undertake hands on lab work and practical activities which develop problem solving abilities required for successful career in pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Department of Chemistry and Analytical Chemistry

B.Sc. (Honors/Research) Chemistry

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
I 4.5	I	101CHE1101 (DSC-I)	Inorganic Chemistry-I	03	45
		101CHE1103	Lab Course-I	01	30
		101CHE1102 (DSC-II)	Organic Chemistry-I	03	45
		101CHE1104	Lab Course-II	01	30
		GE-I	From Basket	04	60
		101CHE1501 (VSC-I)	Systematic Chemistry Laboratory Techniques (SCLT)	02	45
		(SEC-I)	From Basket	02	30
		(AEC-I)	From Basket	02	30
		(VEC-I)	Constitution of India	02	30
		AIPC/OJT-I		02	60
	Total Credits			**22**	
	II	101CHE2101 (DSC-III)	Physical Chemistry-I	03	45
		101CHE2103	Lab Course-III	01	30
		101CHE2102 (DSC-IV)	Inorganic Chemistry -II	03	45
		101CHE2104	Lab Course-IV	01	30
		GE-II	From Basket	04	60
		101CHE2501 (VSC-II)	Analytical Laboratory Techniques	02	45
		(SEC-II)	From Basket	02	30
		(AEC-II)	From Basket	02	30
		(VEC-II)	FSRCE (CBPR)	02	30
		AIPC/OJT-II		02	60
	Total Credits			**22**	
Total Credits (Semester I & II)				**44**	

Curriculum

Major and VSC Courses

Semester - I

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Department of Chemistry

Course Type: DSC-I
Course Title: Inorganic Chemistry-I
Course Code: 101CHE1101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the fundamental concepts like, Electronic configuration, Pauli's exclusion principle, Hund's rule, Aufbau principle, etc.
LO 2. To clarify the concepts of Elements and the periodic Table like: Periodicity, Fundamental properties of atoms, Ionization energy, Electron affinity, Electronegativity and its trends in periodic table.
LO 3. To confront students with periodic Properties of s & p block elements
LO 4. To Study the spectral & magnetic Properties of Transition Metals

Course Outcomes:

After completion of course the student will be able to-

CO 1. Describe the Periodicity, Fundamental properties of atoms, Ionization energy, Electron affinity and Electronegativity.
CO 2. Describe the periodic Properties of s & p block elements.
CO 3. Write the spectral & magnetic Properties of Transition Metals.
CO 4. Explain types of Bonds and Theories of Chemical Bonding

Unit No.	Title of Unit & Contents	Hrs.
I	**Elements and the periodic Table**	**10**
	1. Electronic configuration: Pauli's exclusion principle, Hund's rule, Aufbau principle and their role in writing the electronic configuration. 2. Periodicity: Periodic law, arrangement of elements in the periodic table period, group, diagonal relationship in the periodic table. 3. General properties of atoms: Size of atoms and ions, atomic radii, ionic radii, covalent radii, trends in Periodic table. 4. Ionization energy: Definition, factors effecting, Inert–pair effect, trends of ionization energy in Periodic table, application to explain the chemical behavior of an atom. 5. Electron affinity: Definition, factors affecting, trends of electron affinity in Periodic table, application to explain the chemical behavior of an atom. 6. Electronegativity: Definition, factors affecting, trends of Electronegativity in Periodic table, application to explain chemical bonding.	
	Unit Outcomes: UO 1. Use the Periodic Table to rationalize similarities and differences of elements, including physical and chemical properties and reactivity. UO 2. Define Ionization energy, Electron affinity and Electronegativity.	
II	**sand p- Block Elements**	**10**
	1. Position of the elements in the periodic table	

Unit No.	Title of Unit & Contents	Hrs.
	2. Electronic configuration of elements 3. Hydrides of Alkali & Alkaline earth metals 4. Reducing Properties of S-Block elements 5. Anomalous behavior of first member of each group in P-Block elements 6. Atomic and Ionic Size 7. Ionization energy 8. Electronegativity 9. Oxidation state 10. Bonding and shapes of P_4O_{10}, Diamond, Fullerene, Graphite.	
	Unit Outcomes: UO 1. Tabulate properties of s & p block elements. UO 2. Identify the different allotropes of carbon.	
III	**d- Block Elements**	**10**
	1. Definition, Elements of first, second and third transition series, Electronic Configuration of first transition series. 2. General characteristics of d-block elements, properties of d-block elements (First transition series) such as: Metallic character. Atomic and ionic radii, Melting and Boiling Points, Ionization enthalpies, Reactivity, Oxidation states, Standard electrode potentials, Reducing properties, Colour of ions, Magnetic properties, Catalytic properties and Complex forming tendency.	
	Unit Outcomes: UO 1. Identify paramagnetic and diamagnetic transition metal compound. UO 2. Differentiate between colored and colorless compounds.	
IV	**Chemical Bonding & Acid Base Theories**	**15**
	1. Cause of chemical bonding, types of bonding, octet rule. 2. Ionic bond – Nature of ionic bond, conditions for the formation of ionic compounds, properties of ionic compounds, ion polarization and Fajan's rule. Born-Haber's cycle 3. Covalent bond – Polar and non– polar covalent bond. Percentage ionic character in a polar covalent bond. Hanny and Smyth equation, numericals, properties of covalent compounds. 4. Coordinate bond – Conditions for the formation of coordinate bond, properties of coordinate bond, and properties of coordinate compounds. 5. Metallic bond – Nature of metallic bond (electron pool theory), properties of metals. 6. Hydrogen bond – Nature of hydrogen bond, properties of hydrogen bonding. 7. Vander-waals forces – Types, Nature and origin of Vander -waals forces. Factors affecting the strength of Vander Waals forces. Application of Vander Waals forces. 8. Lewis acid-base concepts and its limitations. 9. Hard-soft acids and bases (Pearson's classification). 10. HSAB Principle. 11. Lux-Flood and Solvent Concept	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO 1. Define Ionic, Covalent and Co-ordinate bond. UO 2. Identify Soft acids and bases &hard acids and bases.	

Learning Resources:

1. Puri, Sharma, Kalia Text Book Of Inorganic Chemistry, Milestone Publications-
2. W.L. Jolly , Modern Inorganic Chemistry (Mc Graw Hill Book company
3. J.E. Huheey, E.A. Keiter, R.L. Keiter Inorganic Chemistry - By Pearson
4. Gurudeep Raj, Chatwal Anand Advanced Inorganic Chemistry Goel Pub., 1974
5. Satyaprakash, G.D. Tuli, S.K. Basu, R.D.Madan, Advanced Inorganic Chemistry, S chandpulicatioin
6. Wilkinson and Cotton, Inorganic Chemistry, Wiley; Third edition
7. J. D. Lee: Fifth Edition, Concise Inorganic Chemistry, Wiley, 2008.
8. Bodie Douglas and DarlMcdaniel: Concepts and Models of Inorganic Chemistry ,Third Edition, Wiley, 1983.
9. Duward Shriver, P. W. Atkins: Inorganic Chemistry, Fifth Edition, Oxford University Press 2002

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry

Course Type: DSC
Course Title: Lab Course –I (Based on DSC-I)
Course Code: 101CHE1103
Credits: 01 **Max. Marks: 50** **Hours: 30**

Leaning Objectives

LO 1. To estimate the amount of substance / ions in given mixture by volumetrically
LO 2. To analyze qualitatively two acidic and two basic radicals.

Course outcomes

After completion of course the student will be able to-

CO 1. Analyze the two acidic and two basic radicals qualitatively
CO 2. Estimate the amount of substances in given mixture by volumetric methods.

Practical No.	Unit
1	Prepare standard Na_2CO_3 solution. Standardize the given HCl solution and estimate the amount of NaOH in the given solution.
2	Estimate the amount of NaOH and Na_2CO_3 in the given mixture using standard HCl solution.
3	Estimate the amount of Fe^{++} and Fe^{+++} separately in the given mixture using standard $K_2Cr_2O_7$ solution.
4	Estimate the amount of Cu^{++} in the given solution using standard $Na_2S_2O_3$ solution.
5	Find out the strength of supplied $AgNO_3$ solution using standard $AgNO_3$ solution. NH_4SCN as link solution (Volhard's method).
6	Find out the strength of supplied NaCl solution using standard NaCl and $AgNO_3$ as link solution (Mohr's method).
7	**Inorganic Qualitative analysis** Qualitative analysis with two acidic radicals and two basic radicals in the form of mixture (Minimum five mixtures) containing one interfering radical: **Acidic radicals:** Carbonate, Chloride, Bromide, Iodide, Nitrate, Sulphate. **Basic radicals:** Copper, Bismuth, Ferric, Aluminum, Manganese, Nickel, Zinc, Barium, Calcium, Magnesium, Ammonium, Potassium.

N.B.: Any Ten Practicals from above.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Department of Chemistry

Course Type: DSC-II
Course Title: Organic Chemistry-I
Course Code: 101CHE1102
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives

LO 1. To clarify the concept of IUPAC nomenclature and structure of organic compound
LO 2. To gain the knowledge of different types of reactions and their mechanism
LO 3. To understand the preparation and properties of saturated unsaturated and aromatic hydrocarbons
LO 4. To determine the Saponification value, Iodine value and Acid value of fats and oil

Course outcomes

After completion of course the student will be able to-

CO 1. Write the IUPAC name of any organic compounds from their structure and draw its structure from its IUPAC name
CO 2. Identify the types of reactions and write its mechanism
CO 3. Explain the preparation and properties of saturated, unsaturated and aromatic hydrocarbons
CO 4. Determine the Saponification value, Iodine value and Acid value of fats and oil

Unit No.	Title of Unit & Contents	Hrs.
I	**Nomenclature of Organic Compounds & Introduction to Reaction Mechanism**	**11**
	1.Development of organic chemistry, unique properties of organic compound 2.Functional groups and types of organic compounds, Basic rules of IUPAC nomenclature, Nomenclature of mono- and bi-functional compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines 3.Substrate and Reagents, Electrophiles & Nucleophiles 4. Homolytic and Heterolytic bond fission. 5.Inductive effect & its, Types Mesomeric Effect, Hyperconjugation &Steric effect 6. Formation and Stability of reactive intermediates: Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes & Arynes 7. Types of organic reactions: Substitution, Addition, Elimination and Rearrangement.	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO 1. Describe the rules of IUPAC Nomenclature. UO 2. Write the IUPAC name of any organic compounds. UO 3. Define reaction intermediates.	
II	**Hydrocarbons - I**	**12**
	1. Alkanes: Introduction, Methods of formation of alkanes by i. Kolbe's electrolytic method ii.Frankland reaction Chemical Properties:halogenation (mechanism), nitration (mechanism). **2. Cycloalkanes:** Introduction, Formation of cycloalkanes by Freund's method Concept of angle strain, stability and reactivity of cycloalkanes: Bayer's strain theory. Ring opening reaction with H_2 & HI. **3. Alkenes**: Introduction Methods of formation by: i.dehydration of alcohols (with mechanism) ii.dehydrohalogenation of alkyl halides (with mechanism).Chemical Reactions: (with mechanism) i. Electrophilic addition of Br_2 to ethane. ii.Free radical addition of HBr to propene (Peroxide effect)	
	Unit Outcomes: UO 1. Classify organic compounds by structure. UO 2. Predict the products of reactions of alkenes and describe the mechanisms showing how the products are formed.	
III	**Hydrocarbons - II**	**11**
	1. Dienes: a. Introduction & classification of dienes b. Resonance & M.O. structure of 1, 3 – butadiene c. Formation of 1, 3 – butadiene from 1, 4 – butanediol d. Chemical properties: i. Addition of H_2& H_2O on 1,3-butadiene ii. Diels – Alder reaction **2. Alkynes:** a. Introduction b. Methods of formation of acetylene (ethyne) from: i. Iodoform ii. Hydrolysis of calcium carbide c. Chemical properties: i. Electrophilic addition reactions of ethyne with Br_2& HBr (with mechanism) ii. Nucleophilic addition reactions of ethyne with by HCN (with mechanism) **3.Benzene:** a. Introduction b. Characteristics of aromatic compounds. c. Kekule structure d. Stability of benzene: resonance and molecular orbital structure of benzene	

Unit No.	Title of Unit & Contents	Hrs.
	e. Modern theory of aromaticity. f. Hackle's rule & its applications to benzene, naphthalene, Anthracene, furan, pyrrole, pyridine, thiophene, cyclohexene, cyclooctatetrene, cyclopropene, cylclopropenyl cation and cyclopentadienyl anion and antiaromaticity. g. Reactions of benzene - Electrophilic substitution reactions (with mechanism), nitration, halogenation, sulphonation, Friedal-craft alkylation and acylation.	
	Unit Outcomes: UO 1. Correctly represent the structures and bonding of alkynes, and describe the mechanisms for reactions of alkynes and predict the products of such reactions. UO 2. Describe the structure of Benzene and its aromatic nature.	
IV	**Halogen Compounds And Fat & Oils**	**11**
	1. Vinyl Chloride: a. Introduction b. Structure- Molecular orbital & Resonance c. Methods of formation of vinyl chloride from: i. Ethene ii. Ethylene dichloride iii.Ethyne. d. Physical properties of vinyl chloride Chemical Reactions of vinyl Chloride: Addition reactions with $Br_2$and HBr. **2. Halo Arenes:** a. Introduction structure and stability of chlorobenzene b. Synthesis of chlorobenzene from: i. Hunsdiecker reaction ii. Gattermann reaction c. Chemical reactions of chlorobenzene: i. Electrophilic substitution reactions ii. Nucleophilic reactions **3. Oils & Fats:** a. Introduction b. Chemical nature c. General chemical properties: i. Hydrolysis ii. Analysis of Fats and Oils: Saponification number(Saponification value),Iodine number (Iodine value),Acid value	
	Unit Outcomes: UO 1. Explain Structure and reactions of Vinyl Chloride. UO 2. Determine the Saponification value of Oils and Fats.	

Learning Resources:

1. S.M. Mukherji, S.P. Singh, R.P. Kepoor (Vol. I & II) Organic chemistry New Age International (P) Ltd., Publishers
2. Organic chemistry by – Jagdamba Singh, L.D.S. Yadav (Vol. I & II),Pragati Prakashan
3. P.L. Soni, A text book of organic chemistry Sultan Chand, 1983

4. K.S. Tewari, S.N. Mehrotra, N.K. Vishnoi. A text book or organic chemistry, Vikas Publishing House
5. Arun Bahl & B.S. Bahl. A text book of organic chemistry S Chand & Company
6. M.K. Jain. Principal of organic chemistry, S. Nagin,
7. Morrison and Boyd. Organic chemistry , Pearson Education
8. Carey. Organic chemistry by Publisher: James M. Smith
9. Jerry March. Advanced Organic chemistry, Wiley
10. P.S. Kalsi. Organic reactions and their mechanism
11. Peter Sykes, A guide book to mechanism in organic chemistry.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Department of Chemistry

Course Type: DSC
Course Title: Lab Course –II (Based on DSC-II)
Course Code: 101CHE1104
Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO 1. To find out Melting point and boiling point of given organic compounds.
LO 2. To study the Crystallization, sublimation and distillation methods of purification of organic compounds.

Course outcomes

After completion of course the student will be able to-

CO 1. Determine the Melting point and Boiling point of given Organic Compounds.
CO 2. Purify the given organic compound by recrystallization, sublimation and distillation.

Practical No.	Unit
1	**A)** Determine the Nature, functional group and physical constant of organic compounds: B-naphthol, benzaldehyde, benzoic acid, p-nitroaniline, acetanilide, nitrobenzene, ethylalcohol and aniline.
2	**B)** Methods of Purification of organic compounds: a) Recrystallization: Benzoic acid, β–naphthol, cinnamic acid, m–nitroaniline and acetanilide b) Sublimation: Naphthalene, camphor. c) Simple distillation: (any one) i) Separate ethanol & water from mixture ii) Separate acetone & water from mixture

N.B.: Any Ten Practicals from above.

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Department of Chemistry

Course Type: VSC-I
Course Title: Systematic Chemistry Laboratory Techniques (SCLT)
Course Code: 101CHE1501
Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

The course covers the broad objectives as to:

LO 1. Introduce the learners about the basic facilities available in school, college and industrial level chemistry laboratories.
LO 2. Impart knowledge of the basics and structure of organization and management of laboratories.
LO 3. Train the learners in the operation and maintenance of chemicals &common apparatus used in laboratories.
LO 4. Familiarize them to develop skills in common laboratory techniques.
LO 5. Trained them in the procedures of procurement and storage of laboratory equipment, apparatus, glassware and chemicals.
LO 6. Enable them to follow appropriate disposal procedures and safety measures required for chemistry laboratories.

Course Outcomes:

After completion of course the student will be able to-

CO 1. Knowledge of all commonly used chemicals, glassware's, apparatus, minor equipment etc
CO 2. Familiarity to cleaning and maintenance of glassware, equipment, apparatus and laboratory.
CO 3. Understanding of theoretical aspects and working principles of chemistry lab wares.
CO 4. Preparation of standard solutions, buffer solutions, indicators, common laboratory reagents.
CO 5. Knowledge to perform the some basic experiments.
CO 6. Knowledge of all safety measures in the chemistry laboratory, proper disposal of chemicals, chemical wastes and other waste materials.
CO 7. Awareness about the handling of corrosive chemicals, lab accidents, fireextinguishersand othersafety means.
CO 8. Knowledge of computer for proper organization and management of chemistry laboratories, minor electronic equipment, maintain lab records, inventory etc.

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction of Chemistry Lab**	**04**
	1. General introduction of chemistry laboratory, common instruction for safe working in chemical laboratories. 2. Lab design, Storage, ventilation, lighting, fume, cupboard, arrangement of store, Safety provisions, 3. Organization of practical work, 4. Maintenance of laboratory, equipment/apparatus, cleaning of laboratories and	

	preparation room. 5. Glass apparatus- Beaker, Test tube, boiling tube, funnel, separating funnel, filtration flask, round bottom flask, flat bottom flask, condenser, Liebig flask, watch glass, measuring cylinder, condenser, petri dish, desiccators etc.	
	Unit Outcomes: UO 1. Identify various equipments& glassware. UO 2. Glassware handles with care.	
II	**Introduction of Lab Apparatus**	**04**
	1. Volumetric Apparatus - Measuring cylinder, burette, pipette, Volumetric flask, etc. 2. Miscellaneous apparatus- Buchner funnel, Bunsen burner, burette stand, retort clamp, china dish/evaporating basin, wire gauze, cork borers, filter pumps, crucible, mohr clip, clay pipe triangle, pestle and mortar, sprit lamp, spatulas, thermometer, pH meter/pH paper etc. and laboratory centrifuge. 3. Apparatus for heating: Bunsen burner, water bath, oil bath hot plate, sand bath, hot air oven, heating mantle etc. Handling and storage of glass apparatus Kipp's apparatus.	
	Unit Outcomes: UO 1. Read the volume of a particular solution in burette. UO 2. Use the water bath, oil bath & sand bath for heating.	
III	**Solution Preparation**	**04**
	1. Water as solvent, types of water, solutions, components of a solution. 2. Types ofsolution, solubility, concentration of solutions: percentage, molarity, normality,molality(inppm) 3. Calculation of masses and volumes for preparation of solutions solids, liquids.	
	Unit Outcomes: UO 1. Calculate amount of solute required for the preparation of standard solution of desired concentration. UO 2. Prepare standard solution of primary standard grade reagent.	
IV`	**Common Laboratory Techniques**	**03**
	1. Refluxing: Apparatus with interchangeable ground glass joints (Quick fit),Filtration: Techniques and filter media, filter paper, simple filtration, 2. Recrystallization: Choice of solvent and precautions with flammable solvents, 3. Distillation: Recovery of solvents through partial distillation, distillation under reduced pressure and Determination of Boiling Point.	
	Unit Outcomes: UO 1. Recrystallize organic compound in suitable solvent. UO 2. Separate ethyl alcohol from the mixture of ethyl alcohol & water mixture.	
V	**Practicals**	**15**
	1. Handling of common laboratory equipment 2. Calibration of volumetric glassware 3. Weighing of chemicals using analytical balance 4. Preparation of solutions, indicators and reagents. 5. Preparation of buffer solutions and determination of their pH Values. 6. Preparation of some organic compound and determination of their melting point. (Any Two)	

	7. Simple acid-base titration. (Any Three) 8. Preparation of distilled/deionized water. 9. Purification of organic compounds by recrystallization. (Any Four)	

Learning Resources:

1. A.I. Vogel. Practical Organic Chemistry.
2. D.V. Jahagirdar, Experiments in chemistry.
3. Dr. O.P. Panday, D.N. Bajpai & Dr. S.Giri, Practical Chemistry, Chand & Company, New Delhi.
4. Day & Underwood, Qualitative analysis: A laboratory manual.
5. O.P. Agarwal. Advanced Practical Organic chemistry.
6. N.K. Vishnoi. Advanced Practical Organic Chemistry.
7. A.I. Vogel. Vogels Qualitative Analysis.
8. A.I. Vogel. Vogels Quantitative Analysis.
9. J.N. Gurutu& R. kapoor. Advanced Experimental Chemistry Vol I, II, III.
10. Balwantraisatuja. Practical Chemistry, Physical-Inorganic-Organic & Viva Voce.

Semester - II

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry & Analytical Chemistry

Course Type: DSC-III
Course Title: Physical Chemistry-I
Course Code: 101CHE2101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives

LO 1. To learn the concepts of concentrations of solutions and colligative properties.
LO 2. To study various methods of determination of viscosity and surface tension of liquid.
LO 3. To Study Bohr's atomic model, concept of shells, sub shells and orbitals, dual nature of electron.
LO 4. To study laws of crystallography.

Course outcomes

After completion of course the student will be able to-

CO 1. Explain the concept of concentrations of solutions and colligative properties.
CO 2. Discuss various methods of determination of viscosity and surface tension of liquid.
CO 3. Describe Bohr's atomic model, concept of shells, sub shells and orbitals, dual nature of electron.
CO 4. Identify Structure of metal crystals, Symmetry elements in the crystals.

Unit No.	Title of Unit & Contents	Hrs.
I	**Solution and Colligative Properties**	**09**
	1. Mole concept, atomic weight, molecular weight and equivalent weight (Definition) 2. Concentration of solution – methods of expressing concentration of solution such as percent by mass, percent by volume, molarity, molality, normality, formality, mole fraction, parts per thousand (ppt), parts per million (ppm) and parts per billion (ppb), numerical. 3. Concentration of bulk solutions used in the laboratory and preparation of standard Solutions from them. (e.g. HCl, H_2SO_4, HNO_3, CH_3COOH and NH_3). Numerical problems on Normality, Molarity and Molality. 4. **Colligative Properties**: Elevation in boiling point, Depression in freezing point, Osmotic pressure, Raoult's law, Relative lowering of vapour pressure.	
	Unit Outcomes: UO 1. Apply these concepts to ideal & real solutions of electrolytes and non-electrolytes as well as colligative properties. UO 2. Define concentrations and prepare solution of desire concentration.	
II	**Atomic Structure**	**11**
	1. Introduction , concept of Atom, Theories of Atomic structure , Discoveries & Properties of Subatomic Particles 2. Bohr's atomic model – Postulates, derivation for radius and energy of Bohr's orbit. Atomic spectra, applications of Bohr's theory to spectra of hydrogen, limitations of Bohr's theory. Numerical on radius and energy of Bohr's orbit	

Unit No.	Title of Unit & Contents	Hrs.
	3. Planck's quantum theory of radiation 4. Compton Effect, Photoelectric effect, explanation on the basis of quantum theory 5. De-Broglie hypothesis – Derivation of de-Broglie equation 6. Heisenberg's uncertainty principle, (Statement, explanation) 7. Concept of Orbit and orbital's, Quantum Numbers – Types, explanation and uses	
	Unit Outcomes: UO 1. Recognize the importance of the quantization of energy. UO 2. Explain atomic structure and the application of the concept of quantization of energy of different orbitals.	
III	**Gaseous State**	**10**
	1. Introduction : Gas laws (Derivation) 2. Kinetic molecular theory of gases – postulates, derivation of kinetic gas equation. 3. Real and ideal gases - behavior, deviation of gases from ideal behavior, compressibility factor (Z), explanation of deviation – Vander Waal's equation. 4. Critical phenomenon – Andrew's isotherms of CO_2, application of Vander Waals equation to Andrew's isotherm, relation between critical constants and Vander Waals constants. Numerical based on this relation. 5. Molecular velocities – RMS, average and most probable velocities. Numerical	
	Unit Outcomes: UO 1. State the gas laws to describe real and ideal gas behavior. UO 2. Derive the ideal gas equation.	
IV	**Liquid State and Solid State**	**15**
	1. Introduction – Intermolecular forces and molecular interactions in liquids. 2. Physical properties of liquids. 3. Vapour pressure – definition, units, effect of temperature. Determination by static and dynamic method, effect of vapour pressure on boiling points. 4. Surface Tension – definition, units, effect of temperature, determination by Stalagmometer (drop no. method). Numerical problems. 5. Viscosity – definition, units, effect of temperature, determination by Ostwald's viscometer. 6. Solid State: Introduction, space lattice, unit cell. The seven type of crystals (Bravais) lattices. 7. Types of cubic systems: simple cubic, BCC, FCC with examples. 8. Structure of metal crystals – HCP and CCP arrangements. 9. Crystallography – Laws of crystallography. i) Law of constancy of interfacial angles. ii) Law of rational indices iii) Law of symmetry. 10. Symmetry elements in the crystals. 11. Weiss indices and Miller indices. Numerical 12. Diffraction of X–rays, Derivation of Bragg's equation	
	Unit Outcomes: UO 1. Define the concept of vapour pressure, surface tension, viscosity and refractive Index of liquid. UO 2. Describe different types of solids and their crystal structure.	

Learning Resources:

1. Physical Chemistry – P.W. Atkins, Julio de Paula (Oxford University Press)
2. Principles of Physical Chemistry – Puri, Sharma & Pathania (Vishal Publishing)
3. Physical Chemistry – Gilbert W. Castellan
4. Physical Chemistry: A Molecular Approach – Donald A. McQuarrie & John D. Simon
5. Elements of Physical Chemistry – P.W. Atkins & Julio de Paula (Oxford University Press)
6. Fundamentals of Physical Chemistry – Maron & Prutton
7. Textbook of Physical Chemistry – Samuel Glasstone
8. Advanced Physical Chemistry – Gurdeep Raj
9. Physical Chemistry – Ira N. Levine
10. Physical Chemistry for the Life Sciences – Peter Atkins & Julio de Paula

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry

Course Type: DSC
Course Title: Lab Course –III (Based on DSC-III)
Course Code: 101CHE2103
Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives

LO 1. To determine equivalent weight.
LO 2. To determine heat of solution, heat of displacement
LO 3. To determine the viscosity, surface tension.
LO 4. To determine the refractive index using Abbes refractometer.

Course Outcomes:

CO 1. Determine equivalent weight of magnesium.
CO 2. Determine the heat of solution, heat of reaction of displacement of copper by zinc.
CO 3. Determine the viscosity, surface tension.
CO 4. Determine the refractive index using Abbes refractometer.

Practical No.	Unit
1	Prepare As_2S_3 from As_2O_3 and compare the precipitation power of NaCl and $MgCl_2$.
2	Determination of interfacial tension between two immiscible liquids (Benzene and Water).
3	Determine the Heat of solution of KNO_3/ NH_4Cl.
4	Determine the heat of reaction of displacement of copper by zinc.
5	Determine the equivalent weight of magnesium by using Eudiometer.
6	Prepare buffer solutions of different pH values i) Sodium acetate-acetic acid ii) Ammonium chloride-ammonium hydroxide
7	Determine the viscosity of given liquid by using Oswald's viscometer.
8	Determine the viscosity of mixture of two liquids A & B and find the composition of the mixture of two liquids. (Density of liquids, viscosity of water to be given) [Any two liquids from: Acetone, CCl_4, Chloroform, Ethyl alcohol. Benzyl alcohol, Ethylene glycol and n-propyl alcohol].
9	Determine the surface tension of a given liquid by using Stalagmometer/Tensiometer.
10	Study the kinetics of hydrolysis of methyl acetate in presence of HCl.
11	Study the variation of viscosity with different concentration of sugar Solutions.
12	Construct the various crystal models of NaCl unit cell.
13	Determine the refractive index of given liquids & calculate Molar refractions. using Abbes refractometer

Learning Resources:

1. A Text book of Practical Chemistry for B.Sc. By V.V. Nadkarny A.N. Kothari and Y.V. Lawande.
2. Experimental Physical Chemistry by A. Findlay.
3. Advanced Practical Physical Chemistry by J.B. Yadav
4. Experiments in Physical Chemistry by R.C. Das and B. Behra
5. Advanced experimental chemistry Vol-I, II and III by J.N. Gurutu and R. Kapoor
6. Systematic experimental Physical Chemistry by S.W. Rajbhoj and Chondekar
7. Experimental in Physical Chemistry by J.C. Ghosh
8. Practical Physical Chemistry by B.D. Khosala and V.C. Garg
9. Experiments in Chemistry by D.V. Jahagirdar
10. Practical Chemistry, Physical – Inorganic – Organic and Viva-Voce by BalwantraiSatuja

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry & Analytical Chemistry

Course Type: DSC-IV
Course Title: Inorganic Chemistry-II
Course Code: 101CHE2102
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To study Principle and Theory of Volumetric Analysis involving Acid and Base.
LO 2. To study Principles and steps involved in Gravimetric analysis
LO 3. To know the reactivity of Noble gases
LO 4. To understand Oxidation – Reduction process and types of corrosion.

Course Outcomes:

After completion of course the student will be able to-

CO 1. Comprehend the principle of Volumetric analysis.
CO 2. Comprehend the principle of Gravimetric analysis.
CO 3. Describe the reactivity of Noble gases
CO 4. Determine oxidation state and concept of corrosion-passivity.

Unit No.	Title of Unit & Contents	Hrs.
I	**Principles involved in volumetric Analysis:**	**10**
	1. Definition of terms: Titrant, standard titrant , titrand, analyte, end point and equivalence point, indicator and titration. 2. Types of titrations: **i) Acid-base titration:** Theory of acid base indicators, Theory of acid-base titration, titration of strong acid-strong base, weak acid-strong base, strong acid-weak base with titration curve and choice of indicators. **II) Redox Titration:** Theoretical basis of volumetric analysis involving (i) Potassium Permanganate (ii) Potassium dichromate and (iii) Iodine. **III) Precipitation titration:** Titration curve for precipitation reaction, end point detection, Mohr's method and Volhard's method. **IV) Complexometric Titration:** Theory of complexometric titration, indicators for EDTA titration, Types of EDTA titration-direct and back titration.	
	Unit Outcomes: UO 1. Able to define Redox, Precipitation and Complexometric Titration. UO 2. Able to explain Basic Terms in volumetric analysis.	
II	**Principles involved in gravimetric analysis :**	**10**
	1. Introduction. 2. Precipitation – Types of precipitants (organic &inorganic), conditions for complete precipitation, types of precipitates, common ion effect, solubility product, factors affecting precipitation.	

Unit No.	Title of Unit & Contents	Hrs.
	3. Purity of precipitates – Co-precipitation, Post-precipitation, Difference between Co-precipitation and Post – precipitation 4. Digestion of the precipitate (Ageing) 5. Filtration 6. Washing of the precipitate, Choice of wash liquid, Properties of good wash liquid 7. Drying of precipitate 8. Incineration and ignition of the precipitate Weighing of the precipitate and Gravimetric Conversion Factor (GCF)	
	Unit Outcomes: UO.1 Know about, Precipitation, filtration, unit operations in gravimetric analysis. UO.2 Understand types and purity of precipitate.	
III	**Chemistry of Noble Gases**	**10**
	1.Introduction 2.Position in the periodic table 3.Isolation 4. Compounds of Inert Gases 5.Uses of Noble Gases	
	Unit Outcomes: UO.1: Describe the reactivity of Noble gases UO.2: Explain different chemical bonds and vander Waals forces, properties, preparation and structure of different inert gases	
IV	**Oxidation-Reduction and Corrosion-Passivity**	**15**
	A) Oxidation-Reduction 1.Definition of oxidation, reduction, oxidizing agent and reducing agents according to electronic concept 2. Definition of oxidation, reduction, oxidizing agent and reducing agents according to oxidation number concept. 3. Rules for assigning oxidation number. 4 Balancing of redox reaction by 1) Ion – electron method and 2) Oxidation number method. **B) Corrosion-Passivity:** 1.Definition of corrosion of metal 2.Types of corrosion – i) Atmospheric ii) Immersed 3Theory of corrosion – Electrochemical theory 4 Factors affecting corrosion : i) Position of metal in electro chemical series ii) Purity of metal iii) Effect of moisture iv) Effect of oxygen v) Effect of pH vi) Physical state of metal 5 Methods of prevention of corrosion of metals: i) Purification of metal ii) Alloy formation	

Unit No.	Title of Unit & Contents	Hrs.
	iii) Making metal cathodic. **Passivity:** Definition Theories of Passivity: i) Oxide film theory ii) Gaseous film theory	
	Unit Outcomes: **1.** Can find out the oxidation number of various elements. 2.Understand about types of corrosion, theory of corrosion, factors affecting on corrosion	

Learning Resources:

1. A text book of Inorganic Chemistry by Vinod Mane, Vijay More, Bhagwant Gurme.
2. Inorganic chemistry: H.C.Khera.
3. Modern analytical chemistry: W. F. Pickering, Marcel Decker INC. New York.
4. Analytical Chemistry, 7th Edition, By Gary D. Christian, Purnendu K. Dasgupta, Kevin Schug · 2013
5. Basic concepts of analytical chemistry: S. M. Khopkar.
6. Fundamentals of analytical chemistry: D. A. Skoog, D.M. West and H. J. Holler, 7 edition.
7. Analytical Chemistry Principles: J. H. Kennedy, W. B. S. Saunders pub. Ltd.
8. Inorganic chemistry: H.C.Khera
9. Principles in semi-micro qualitative analysis: G. R. Chatwal edited by M. Arora.
10. College Analytical Chemistry: Baliga Shetty.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry

Course Type: DSC
Course Title: Lab Course –IV (Based on DSC-IV)
Course Code: 101CHE2104
Credits: 01 **Max. Marks: 50** **Hours: 30**

Leaning Objectives

LO 1. To prepare standard solution of reagent.
LO 2. To estimate the amount of substance / ions in given solution by volumetrically.

Course outcomes

After completion of course the student will be able to-

CO 1. Prepare standard solution of reagent.
CO 2. Estimate the amount of substances in given solution by volumetric methods.

Practical No.	Unit
1	Preparation of standard solution of potassium hydrogen phthalate and standardization of sodium hydroxide solution.
2	Preparation of standard solution of $K_2Cr_2O_7$ and standardization of given FAS solution.
3	Preparation of standard solution of oxalic acid and estimation of given KMnO4 solution.
4	Preparation of Iodine solution and its standardization using Sodium Thiosulphate.
5	Preparation of standard solution of NaCl and standardization of given $AgNO_3$ solution.
6	Assay of commercial sodium hydroxide/barium hydroxide.
7	Estimation of H_2O_2 solution.
8	Estimation of formaldehyde.
9	Determination of alkalinity of water sample.
10	Preparation of standard solution of Zinc Sulphate and estimation of given EDTA solution.
11	Estimation of Nickel by EDTA Titration.

Learning Resources:

1. A Text book of Practical Chemistry for B.Sc. By V.V. Nadkarny A.N. Kothari and Y.V. Lawande.
2. Advanced experimental chemistry Vol-I, II and III by J.N. Gurutu and R. Kapoor
3. Systematic experimental Physical Chemistry by S.W. Rajbhoj and Chondekar
4. Practical Chemistry by B.D. Khosala and V.C. Garg
5. Practical Chemistry, Physical – Inorganic – Organic and Viva-Voce by Balwantrai

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry and Analytical Chemistry

Course Type: VSC-II
Course Title: Analytical Laboratory Techniques (ALT)
Course Code: 101CHE2501
Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

The objective of this course is to train students about:

LO 1. Understand the principles and working mechanisms of various laboratory instruments used in chemistry experiments.
LO 2. Gain proficiency in chromatography techniques and understand their applications.
LO 3. Develop awareness of laboratory safety protocols related to chemical, fire, and gas hazards to ensure safe handling and disposal of chemicals.
LO 4. Perform essential chemistry experiments including preparation of buffers, titrations, spectrophotometric analysis, and pH determinations using various laboratory techniques.

Course outcomes:

After completion of the course the student will be able to-

CO 1. Identify and operate laboratory instruments with proper handling techniques.
CO 2. Analyze chemical compounds using chromatography techniques and interpret results based on experimental observations.
CO 3. Apply laboratory safety measures while handling hazardous chemicals, gases, and fire-related incidents in a chemistry lab.
CO 4. Demonstrate proficiency in practical analytical techniques and structure drawing using ChemDraw and ChemSketch.

Unit No.	Title of Unit & Contents	Hrs.
I	**Laboratory Instruments**	**04**
	1. Instruments for Physical Properties –Introduction to instruments. 2. Glass Instruments - Viscometer, Stalagmometer, Calorimeter. 3. Electrical Instruments - Conductometer, pH meter, Refractometer Polarimeter, Colorimeter. 4. Analytical Instruments - Flame Photometer, Atomic Absorption Spectrophotometer.	
	Unit Outcomes: UO 1. Will be able to identify various instruments. UO 2. Understand how to handle various instruments with utmost care.	
II	**Chromatography - I**	**04**
	1. Introduction – Need for Chromatography, Origin of Chromatography. 2. Terminology of Chromatography. 3. Types of Chromatography. 4. Column Chromatography - Principle, Apparatus, Procedure, Advantages & Limitations, and Applications. 5. Applications of Chromatography.	
	Unit Outcomes:	

	UO 1. Will be able to explain the meaning of the terms in Chromatography. UO 2. Explain the mechanism of column chromatography.	
III	**Chromatography - II**	**04**
	1. Paper Chromatography - Principle, Apparatus, Procedure, Types of Paper Chromatography, Advantages & Limitations, and Applications. 2. Thin Layer Chromatography (TLC) - Experimental Arrangement for TLC, TLC Kits and their Use, Running A TLC Chromatogram (Ascending Technique), Method, Retardation Factors, Identification of Components.	
	Unit Outcomes: UO 1. Explain the mechanism of Thin Layer Chromatography. UO 2. Learn about the techniques of Paper Chromatography.	
IV`	**Chemistry Laboratory Safety**	**03**
	1. Fire Hazards: Causes of fires, classification of fires, fire prevention protocols and measures, fire alarms, fire escapes, fire Extinguishers and their uses. 2. Chemical Hazards: Classification and handling of hazardous chemicals, storage of chemicals, transfer through large containers. 3. Gas Hazards: usage of LPG and CNG safer in the laboratory, detection and handling of Gas Leakage, health hazards of gases.	
	Unit Outcomes: UO 1.Understand need to follow appropriate safety precautions while dealing with chemicals. UO 2. Describe how to handle hazardous chemicals and gases.	
V	**Practicals**	**15**
	1. Preparation of buffers. 2. Preparation of standard solution of EDTA. 3. Estimation of sodium carbonate by titrating with Hydrochloric acid. 4. Determination of iron in a given solution by using an internal indicator. 5. Determination of iron in a given solution by using an external indicator 6. Homogeneous precipitation of the Nickel as its Dimethylglyoxime. 7. Determination of refractive index of given organic liquids by Abbe's Refractometer. 8. Calibration of UV-visible Spectrophotometer, pH Meter, Potentiometer, Conductometer etc. 9. Determination of pH of soil. 10. Titration of acid-base using pH meter. 11. Determinations of pH of given dilute solutions of shampoos and soaps. 12. Determination of aspirin by conductometry. 13. Verification of Lambert-Beers law using colorimetry. 14. To draw chemical structures in chemdraw. 15. To draw chemical structures in chemsketch.	

Learning Resources:

1. Fundamentals of Analytical Chemistry – Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch – Cengage Learning.
2. Analytical Chemistry – Gary D. Christian – Wiley.

3. Undergraduate Instrumental Analysis – James W. Robinson, Eileen M. Skelly Frame, George M. Frame II – CRC Press.
4. Vogel's Textbook of Quantitative Chemical Analysis – J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas – Pearson.
5. Principles of Instrumental Analysis – Skoog, Holler, Nieman – Cengage Learning.
6. Spectrometric Identification of Organic Compounds – R. M. Silverstein, F. X. Webster, D. J. Kiemle – Wiley.
7. A Textbook of Engineering Chemistry – S. S. Dara – S. Chand Publishing.
8. Analytical Chemistry: Principles – J. H. Kennedy – Saunders College Publishing.
9. Chemistry of Atmospheres: An Introduction to the Chemistry of the Atmospheres of Earth, the Planets, and Their Satellites – R. P. Wayne – Oxford University Press.
10. Practical Organic and Biochemistry Techniques – Iain M. Campbell, Richard D. Archer – Cambridge University Press.

Skill Enhancement Courses Offered by the Department

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Chemistry
Semester I & II

Course Type: SEC-I
Course Title: Pesticides and Green Chemistry
Course Code: 101CHE1601
Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

The course covers the broad objectives as to:

LO 1. To familiarize the students with Classification, History and innovation of pesticides.
LO 2. To understand the Concept, Principles, Needs and Goals of Green Chemistry

Course Outcomes:

After completion of course the student will be able to-

CO 1. Define concept, Chemical nature, History of pesticides etc.
CO 2. ExplainConcept, Principles, Needs and Goals of Green Chemistry.

Unit No.	Title of Unit & Contents	Hrs.
I	**Chemistry of Pesticides**	**10**
	1. Definition, importance & general classification of agrochemicals. Classification of pesticides on chemical nature and according to target species, mode of action. 2. Introduction: History of pesticides, innovation of pesticides chemistry, development of pesticides. 3. Brief introduction to structure, chemical name, physical properties, chemical properties, synthesis, degradation, metabolism, formulations, mode of action, uses, toxicity (acute and chronic toxicity in mammals, birds, aquatic species etc.)&methods of analysis.	
	Unit Outcomes: UO 1. Define various terms and concept related Pesticides. UO 2. Classify Pesticides on the basis of their chemical nature.	
II	**Green Chemistry**	**05**
	1. What is Green Chemistry? Need for Green Chemistry. 2. Goals of Green Chemistry. 3. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry 2. Twelve principles of Green Chemistry with their explanations.	
	Unit Outcomes: UO 1. Identify Green Synthesis. UO 2. Tabulate twelve principles of Green Chemistry.	
V	**Practicals**	**30**
	1. Estimation of available chlorine in bleaching powder 2. Determination of bulk density of pesticidal WP/WDG/Dust/SP.	

	3. Determination of copper from Bordeaux mixture as fungicides by iodometric titration. 4. Estimation of Organophosphorus insecticide residues in soil by visible spectroscopic. 5. Separation and detection of pesticide by thin layer chromatography.(Any Three Samples) 6. Determination of emulsion stability and cold test of pesticide. 7. Synthesis of pesticides/analogs a. Phenyl benzoate. b. Acetanilide c. DDT d. BHC e. 2,4 D	

Learning Resources:

1. A.I. Vogel. Practical Organic Chemistry.
2. D.V. Jahagirdar, Experiments in chemistry.
3. Dr. O.P. Panday, D.N. Bajpai & Dr. S.Giri, Practical Chemistry, Chand & Company, New Delhi.
4. Day & Underwood, Qualitative analysis: A laboratory manual.
5. O.P. Agarwal. Advanced Practical Organic chemistry.
6. N.K. Vishnoi. Advanced Practical Organic Chemistry.
7. A.I. Vogel. Vogels Qualitative Analysis.
8. A.I. Vogel. Vogels Quantitative Analysis.
9. J.N. Gurutu& R. kapoor. Advanced Experimental Chemistry Vol I, II, III.
10. Balwantraisatuja. Practical Chemistry, Physical-Inorganic-Organic & Viva Voce.

Baskets of Common Courses

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG First Year

Basket I: Generic/Open Elective (GE/OE)

(GEs offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing GE/OE	Code	Course Title	Credits	Hrs.
1	Commerce		Mutual Fund Management	04	60
2	Commerce		Fundamentals of Statistics	04	60
3	English		English for Science and Technology	04	60
4	Geography		General Geography	04	60
5	Commerce		Personal Financial Management	04	60
6	Marathi		स्पर्धापरीक्षाआणिमराठीभाषा	04	60
7	Political Science		Human Rights	04	60
8	Biotechnology		Nutrition, Health and Hygiene	04	60
9	Music		Indian Vocal Classical & Light Music	04	60
10	NCC Studies		Introduction to NCC	04	60
11	Sports		Counseling and Psychotherapy	04	60

Note: Student can choose any one GE from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG First Year

Basket II: Skill Enhancement Courses (SEC)

(SEC offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing SEC	Code	Course Title	Credits	Hrs.
1	Chemistry		Pesticides and Green Chemistry	02	30-45
2	Information Technology		Basics of Python Programming	02	30-45
3	Physics		Physics Workshop Skills	02	30-45
4	Biotechnology		Food Processing Technology	02	30-45
5	Botany		Mushroom Cultivation Technology	02	30-45
6	English		Proof Reading and Editing	02	30
7	Information Technology		PC Assemble and Installation	02	30-45
8	Marathi		कथा/पटकथालेखन	02	30
9	Zoology		Bee Keeping	02	30-45

Note: Student can choose any one SEC from the basket.

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Basket III: Ability Enhancement Courses (AEC)

(AEC offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing AEC	Code	Course Title	Credits	Hrs.
1	Marathi		भाषिक कौशल्य भाग – १	02	30
2	Hindi		हिंदी भाषा शिक्षण भाग – १	02	30
3	Sanskrit		व्यावहारीक व्याकरण व नितिसुभाषिते	02	30
4	Pali		उपयोजित व्याकरण	02	30
5	English*		Communicative English-I	02	30

Note:

1. **Student (other than Computational Science, Computer Applications & Biotechnology) can choose any one AEC (Sr. No. 1 to 4) from the basket.**
2. ***This course is applicable only for Computational Science, Computer Applications & Biotechnology students.**

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Extra Credit Activities

Sr. No.	Course Title	Course Code	Credits	Hours T/P
1	MOOCs		Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses		Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken English Courses		Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.

3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

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Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
DSC/DSE/ GE/OE/Minor	100	10	10	20	10	-	-	40	60	100
DSC	75	05	10	15	10	-	-	30	45	75
Lab Course/AIPC/ OJT/FP	50	-	-	-	-	05	20	-	25	50
VSC/SEC/ AEC/VEC/CC	50	05	05	10	05	-	-	20	30	50

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks.